

PATENT APPLICATION BASED ON:

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**METHOD FOR SAVING POWER IN AN ORGANIC
ELECTROLUMINESCENT DISPLAY**

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**METHOD FOR SAVING POWER IN AN ORGANIC
ELECTROLUMINESCENT DISPLAY**

FIELD OF THE INVENTION

5 This invention relates generally to organic electroluminescent displays, and more particularly, to a method for reducing the power consumed by an organic electroluminescent display panel.

BACKGROUND OF THE INVENTION

10 Full color organic electroluminescent flat panel displays such as organic light emitting diodes (OLEDs) consist of two dimensional arrays of discrete light emitting elements. A common configuration for such a device includes columns of alternating red, green and blue emitting elements. Another configuration includes closely placed triplets of light emitting elements, each
15 triplet consisting of one each of a red, green and blue light emitting diode. Color organic electroluminescent flat panel displays are presently planned for wide use in battery powered portable electronic devices such as personal computers, digital assistants and cellular telephones. A common problem with such apparatus is the limited time of operation before the battery must be replaced or recharged. One
20 approach to saving power is to automatically put the device into a minimum power usage sleep mode if there has been no active use of the device for a predetermined time. This approach however is not very useful if the device is continually in use. There is a need therefore for an improved method of conserving power

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SUMMARY OF THE INVENTION

 The need is met according to the present invention by providing a method of saving power in a color organic electroluminescent display of the type having color emitting elements with different light emitting efficiencies, that
30 includes the steps of: determining the color of the elements having the highest efficiency; converting a color digital image to be displayed on the display to a

monochrome image; and displaying the monochrome image using the determined color elements.

ADVANTAGES

The present invention has the advantage that power can be saved
5 while continuing to use the display device.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a ~~schematic diagram illustrating the normal full color~~
operation of an organic electroluminescent display;

10 Fig. 2 is a schematic diagram illustrating the power saving mode of
operation of an organic electroluminescent display according to the present
invention; and

Fig. 3 is a schematic block diagram of a battery powered cell
phone having an organic electroluminescent display capable of being operated in
15 a power saving mode according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a method of conserving power
in a portable OLED device. OLEDs create a color image by emitting colored
20 light at each individual pixel site. The OLED has a useful property in that the
only light emitting elements that consume power are the light emitting elements
that are turned on. In other words, the power consumed by the OLED device can
be reduced by turning individual light emitting elements off. It is known that the
various colors of OLED materials do not create light with the same efficiencies.
25 The present invention takes advantage of this property to provide a method for
displaying an image using the most efficient light emitting channel of the OLED
device. This display mode saves power by turning off the less efficient color
channels, and using the most efficient channel for displaying the image.

A typical active matrix OLED display has red, green and blue light
30 emitting elements. When all of the light emitting elements are off, the display

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consumes a minimum of power, and the display appears black. When all of the light emitting elements are turned on, the red, green and blue light mixes, and the display appears white. The materials used to produce the different colors of light do not have the same light emitting efficiencies. Some of the materials will produce more light output than others, for a given amount of input current. For example, the green light emitting materials are often the most efficient, and may be as much as four or five times as efficient as the blue material, which is the least efficient.

Fig. 1 shows the normal mode of operation of a full color OLED display 10, the data from each color channel (12, 14, 16) is used to drive the corresponding colored light emitting elements (18, 20, 22) in the OLED display 10.

It is known that the luminance content of a colored image can be represented by adding together a weighted portion of each of the intensities of the red, green and blue components of the image. For example in one known technique for converting a color image to a monochrome image, the relative weighted amounts of red, green and blue used to produce a gray scale luminance value are:

$$\text{Luminance} = (5/16) * \text{red} + (9/16) * \text{green} + (2/16) * \text{blue} \quad (1)$$

Fig. 2 shows how the image data can be processed by multiplying the data in each channel by a fraction (24, 26, and 28) and summing (30) the processed channels to produce a weighted luminance sum, and that sum is used to drive one of the channels (e.g. the green channel) on the OLED display.

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25 Referring to Fig. 3, in certain portable applications, such as a cellular telephone 32, it may be acceptable to switch from a full power, full color mode to a low power monochrome mode. The cell phone 32 includes a full color OLED display 10. A transceiver 34 is connected to an antenna 36 and a controller 38. The cell phone is operated by a keypad 40 connected to the controller. The controller sends signals to a digital image processor 42 that in turn sends processed digital image signals to a display driver 44 that drives the display. A

power supply, such as a battery pack 46 supplies power to the components of the cell phone, including the display 10. A power supply monitor 48 is connected to the power supply 46 and signals the controller as to state of charge of the batteries in the power supply.

5 When the battery 46 is low on stored power, it may be more important to use the remaining power to receive and transmit, than to display full color on the OLED display 10. This low power monochrome mode can be achieved by converting the full color RGB color image to a luminance only gray scale image as described above in the digital image processor 42, and displaying
10 that monochrome image on the green light emitting elements (only) of the OLED display 10. The inefficient red and blue light emitting elements would all be turned off, and the image would be displayed on the efficient green light emitting elements. The low power mode of operation can be selected manually, for example by a code that is input into the keypad 40, or automatically by the
15 controller in response to the signal provided by the power supply monitor 48.

 The present invention is also useful in devices such as laptop computers and personal digital assistants, for example, by providing the option to switch to a power saving mode when doing tasks such as word processing that don't necessarily require full color.

20 The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

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